Calculation of Cosmological Observables from Constants of Nature *

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Abstract

Hubble's constant is calculated exclusively from the constants of nature, e, α, c, and $\hbar$, yielding the value 71.36 km/second/Mparsec. Corroborative results can be obtained from a quantum fluctuation scenario of the early universe. The theory also yields the radius of the universe, $1.296 \times 10^{26}\ m$, its energy density, $1.72 \times 10^{-9} J/m^3$, and age, $13.7 \times 10^9\ years$, and the energy density of CBR, $0.286 \times 10^6\ eV/m^3$.[1]

1 INTRODUCTION

A recently developed relativistic construct [1,2,3] identifies two space-like separated observers who measure respectively an orbital velocity as seen from origo and line increments in the direction of observation as seen from the periphery towards the center. The peripheral observer performs direct measurements in one spatial dimension whereas the observer at origo is non-local in the sense of only being capable of measurements on the time axis. This construct naturally accommodates the Sommerfeld equation of relativistic electron energy as well as the Bohr atom in its ground state. The theory also, for the first time, offers a framework for determining cosmological parameters based on plain quantum physical considerations. In this application, observations are made towards the non-local frame at origo and the numerical values derived from the Bohr atom are related to the cosmological scale. This approach is consistent with the fact that almost all information about the physical world and the universe has its origin either in signaling from atoms or the Planck distribution. In contrast, previous theoretical approaches to the subject solely rely on gravity and thermodynamics and often involve extensive hypothesizing about the expansion of the universe into a pre-formed space-time.

 Theory first published in July 2003, calculations republished with numerical revisions in March 2005 and July 2014, Appendix and footnotes added in 2014.

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[1]or $0.256 \times 10^6 eV/m^3$ based on an alternative approach published in 2012, see Appendix I

2 RESULTS

It is customary to evaluate Hubble's constant by comparing results of different types of measurement while relating to some relevant theory. A recently reported method of determining Hubble's constant is based on equating the gravitation of the universe as measured from the cosmological horizon with particle creation at the horizon [1]. The cosmological horizon is defined as the laboratory frame, which is space-like separated from a frame at origo at a radial distance equal to and no longer than as given by having the most distant expansion rate equal to the velocity of light. The generation of primordial matter is estimated from the decay of the Λ_0 particle in a non-standard quantum fluctuation scenario of the early universe. This method of calculating Hubble's constant yields the value $7.668 \times 10^{-27} s^{-1}$ [1] (The symbol s is used here for the geometrized unit of time to distinguish from SI units, *sec*). Corroborative data can be obtained by factorizing the Planck length in terms of the apparent expansion rate based on numerical data obtained from the Bohr atom [2], yielding

$$H = \sqrt{\hbar}\ \frac{\pi}{2} \frac{2\alpha}{e\ c}\ Ampere\ =\ 7.714 \times 10^{-27} s^{-1} \tag{1}$$

where e is the elementary charge, α is the fine structure constant, $c = m/s$ is the velocity of light, and $\hbar$ is the reduced Planck's constant. This value, corresponding to 71.36 km/sec/Mparsec agrees within experimental errors with that obtained from the particle decay and is also within acceptable limits of current astronomical observations [4]. In Eq. 1, two lengths (plain or geometrized) are related by electromagnetic entities expressed in SI-units with magnitude.

$$\frac{e\ c}{\pi\ \alpha\ Ampere} = 2.095 \times 10^{-9} = \frac{1}{48.38 \times 10^{6}\ \pi^{2}}\quad . \tag{2}$$

The reported Lorentz construct allows the identification of a radius the magnitude of which is numerically given by the inverse of the line increment, $\bar{q}_0 = -m^2/\Delta\bar{q}$. Applying $v \leq c$ to the distant expansion rate identifies this as the radius of the universe, $1.296 \times 10^{26}\ m$ with volume, $V_u = 9.127 \times 10^{78}\ m^3$, and the average energy density, ρ_u, is directly obtained as $1.296 \times 10^{26} \times 1.2105 \times 10^{44}/V_u = 1.719 \times 10^{-9} Joule/m^3$, which is almost exactly twice the published value based on standard cosmology, $0.851 \times 10^{-9} J/m^3$. The age of our universe is defined by the time it takes for a light signal to go from origo (the origin of space and time coordinates) to the cosmological horizon (=the laboratory frame), $1/(c\ \bar{\Delta q}\ m^{-2}) = 13.7 \times 10^{9}\ years$. Exactly the same numerical value has been obtained based on standard cosmological models [cf. 5].

Much attention has been given through the years to the cosmic background radiation at 2.7 degrees Kelvin. Since $\Delta\bar{q} << 1$, Rayleigh-Jeans' law of energy density of radiation emerging from a hot cavity,

$$U(\nu) = \frac{8\ \pi\nu^2}{c^3} kT\quad , \tag{3}$$

where U is the energy density of radiation of frequency ν, k is Boltzmann's constant and T is absolute temperature, may be used for the present purposes. The frequency is set to $\Delta\bar{q}/ms$. Since this is interpreted as a global and unique vacuum instability in the present theory there is no need to sum over frequencies. Furthermore, $\bar{h} = \Delta\bar{q}m$ corresponds to

Planck's constant in the present geometry (cf. 1, 2,4) and the mass is measured in units of 's' . Having the relation $\Delta\bar{q}/m = -m/\bar{q}_0$ for the unit radius, the source of CBR is assigned to the non-local origo by replacing the frequency s^{-1} for $\Delta\bar{q}/ms$. The non-local origo in the present theory is equivalent of the cosmological horizon in standard cosmological models. Eq. 3 may then be written as

$$U(\Delta\bar{q}) = 8\ \pi\ (\frac{m}{ms})^2\ (\frac{s^3}{m^3})\ kT \quad , \tag{4}$$

which has units $m^2/(sm^3) = 1/(ms)$ in the present geometry[2].

Since electromagnetic radiation like CBR requires Planck's constant rather than an apparent cosmological expansion rate the transformation between the two lengths $\Delta\bar{q}$ and $\hbar/m$ expressed by Eq. 2 is then applied to Eq. 4.[3] Using the SI-derived numerical GU value for the Boltzmann's factor kT with CBR at 2.725 ^oK, 3.108 $\times$ 10^{-67} m,

$$U_{CBR} = 8\pi\ 48.38 \times 10^6\ kT\ m^{-3} = 3.78 \times 10^{-58} m^{-1} s^{-1} = 0.286 \times 10^6 eV/m^3 \quad , \tag{5}$$

whereas the published standard cosmological model value of the energy density of CBR is $0.2604 \times 10^6 eV/m^3$, corresponding to $3.447 \times 10^{-58} m^{-2}$ [6]. Thus, the CBR appears to be straightforwardly associated with Hubble's constant on the basis of the present cosmological model.[4]

3 DISCUSSION

The present results show for the first time that plausible numerical values of several cosmological observables can be calculated directly from constants of nature. The use of fixed boundary conditions for the observables within a well-defined quantum physical framework circumvents any speculations about the history of the universe including the problem of its closure in the "Big Bang" hypothesis. A numerically more confident determination of Hubble's constant and the CBR than in standard models is made possible while maintaining the notion of the latter's distant origin. All numerical values are within acceptable limits of contemporary astrophysics. The somewhat higher value of the energy density than in standard models might be necessary for nucleation of matter given that an early expansive

[2]energy density per frequency = right side $\Rightarrow$ energy density = right side times frequency

[3]If $\bar{h} = \Delta\bar{q}m$ corresponds to Planck's constant then $\bar{h} = \Delta\bar{q}m = (\Delta\bar{q})\ (\bar{q}\Delta\bar{q})$ wherein, because of $H = \Delta\bar{q} = 1/\bar{q}$,any transformation factor applied to the last term cancels out and the transformation factor is only applied once. Its value as shown in Eq. 2 is 48.38×10^6 wherein $1/2.095 \times 10^{-9}$ has been further divided by $\pi \times \pi$ (once for every unit length, that is), which is motivated by achieving a better numerical agreement: The correction is justified if the classical Planck length involves rotation on the unit circle and this is accommodated in some way by the one-dimensional geometry of $\bar{q}\Delta\bar{q}$ The compression of three dimensions into one dimension is actually implicit in the way the numerical value of the universe's energy density is obtained here. In contrast, the classical derivation of Rayleigh-Jeans' law involves the number of standing waves, which is a one-dimensional concept.

[4] It is not necessary to pursue these lines of thought since there is now another way of calculating the energy density of the CBR based on excitations of a Rydberg atom extending to the cosmological horizon (see Appendix I).

phase is not in the focus of the present theory. Also standard models must face the factually observed matter deficiency.

It is remarkable that all previous world pictures in physics are based on Newtonian or Einsteinian gravity even though the Sommerfeld and Bohr atoms have been known for more than 80 years and offer a more direct access to the information emerging from the real world. The numerical agreement between the macroscopic world picture based on gravity and the microscopic one based on the hydrogen atom reported here suggests that either one (or both) may be right.

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Appendix I

Another way of calculating the energy density of the CBR was discovered in 2012[5]. This is based on regarding the entire universe as a Rydberg atom where the elementary charge circulates at the periphery in such a way that it generates the CMBR. In this approach the apparent Hubble expansion rate of dimension m^{-1} is interpreted as a frequency with energy $E/2\pi = \hbar\nu$. Like in Eq. 4 above the local rate (frequency) is amplified and transferred to the relativistic horizon by multiplying with the radius of the universe, r_u and a scaling factor of $a_0\alpha$ is applied (eq. 35 in the footnote reference) yielding

$$U(CMBR) \times m^3 = \hbar \frac{r_u H}{2a_0\alpha} = \hbar \frac{r_u \Delta v_{e,ru}}{(a_0\alpha)^2}; \quad \frac{2.612 \times 10^{-70}}{2 \times 5.2912 \times 10^{-11} \times 0.07297} = 3.382 \times 10^{-58}, \tag{6}$$

$$= 0.256 \times 10^6 eV/m^3 \quad {}^{6} \tag{7}$$

By reference to Gauss's theorem (and possibly Stoke's theorem) where all but the boundary terms cancel, the CMBR may thus be interpreted as evidence that the universe is limited in size and extends to its relativistic horizon at $1.296 \times 10^{26} m$. At this distance, the CMBR is generated by elementary charges undergoing Bohr type excitations and relaxations accommodated by the term Δv_u. This method of calculating the energy density of the CMBR has the advantages over the Rayleigh-Jeans method above that it 1) pinpoints a plausible physical mechanism for its generation, 2) involves fewer conjectures and 3) gives a better numerical agreement with the experimental value.

[5] E. Cerwen (May 18, 2012) Exploring the edge of the universe in a spacecraft made of one hydrogen atom. Proceedings of www.scienceandresearchdevelopmentinstitute.com, Quantum Physics and Cosmology # 18

[6] In the 2000 edition of Astrophysical Constants at http://pdg.lbl.gov the energy density of the CMBR was given the value $0.26038(T/2.725)^4 eV/cm^3$. Hence, the numerical agreement between the theoretical value above and the experimental value extends to the 3:rd digit.